SHOTCRETE **(4-15-08)**

1.0 DESCRIPTION

This special provision addresses shotcrete produced by either the dry or wet mix process used for temporary support of excavations and other applications as shown on the plans or directed by the Engineer. Provide shotcrete composed of portland cement, water, aggregate and at the Contractor's option, pozzolan. Type IP blended cement may be used in lieu of portland cement and fly ash and Type IS blended cement may be used in lieu of portland cement and ground granulated blast furnace slag. If necessary, use admixtures for shotcrete produced by the wet mix process. Proportion, mix and place shotcrete in accordance with the plans, the applicable section of the *Standard Specifications* or special provision for the application and this provision.

2.0 MATERIALS

Refer to Division 10 of the *Standard Specifications*:

Item	Article
Cement	1024-1
Water	1024-4
Fine Aggregate, 2S or 2MS	1014-1
Coarse Aggregate	1014-2
Fly Ash	1024-5
Ground Granulated Blast Furnace Slag	1024-6
Silica Fume	1024-7
Admixtures	1024-3

3.0 REQUIREMENTS

Unless required elsewhere in the contract, provide shotcrete with minimum compressive strengths as follows:

Property	Requirement
Compressive Strength @ 3 days	2000 psi (13.8 MPa)
Compressive Strength @ 28 days	4000 psi (27.6 MPa)

Submit shotcrete mix designs in terms of saturated surface dry weights on M&T Form 312U in accordance with the applicable section of the *Standard Specifications* or special provision for the application. If the Contractor desires to mix shotcrete by volume, contact the NCDOT Materials and Tests (M&T) Unit before submitting mix designs. Adjust mix proportions to compensate for surface moisture contained in the aggregates at the time of mixing. Use an approved testing laboratory to determine the shotcrete mix proportions. Changes in mix proportions will not be permitted unless a revised mix design submittal is accepted.

When shotcrete mix designs are submitted, the Engineer will review the mix designs and notify the Contractor as to their acceptability contingent upon compressive strength test results for cores from preconstruction test panels. Do not use mix designs for preconstruction test panels until written acceptance has been received. Acceptance of shotcrete mix designs does not relieve the Contractor of responsibility to furnish a product that meets the contract requirements.

4.0 PRECONSTRUCTION TEST PANELS

Before beginning construction, furnish at least 1 preconstruction test panel for each shotcrete mix design and nozzleman using the same equipment that will be used for construction. Use 3 ft by 3 ft (1 m by 1 m) forms at least 4" (100 mm) thick for test panels.

Determine air content for shotcrete produced by the wet mix process in accordance with AASHTO T152 or T196. Batch, deliver, mix and place shotcrete in accordance with Section 5.0 and the applicable section of the *Standard Specifications* or special provision for the application. Make preconstruction test panels in the presence of the Engineer with forms in a vertical position and from the same shooting position anticipated for construction. Do not disturb test panels within the first 24 hours and cure panels in accordance with AASHTO T23 without immersing panels.

Drill 3" (75 mm) dia. cores in accordance with AASHTO T24. Extract 6 cores from each preconstruction test panel and provide them to the Engineer. The compressive strength of the shotcrete will be considered the average compressive strength test results of 3 cylinder specimens from the same preconstruction test panel at 28 days.

5.0 SAMPLING AND PLACEMENT

Use equipment capable of handling and delivering shotcrete at a steady uninterrupted flow. Use air supply systems that deliver clean, dry air free of contamination and capable of maintaining sufficient nozzle velocity at all times. Apply shotcrete with the same equipment and methods as used for the preconstruction test panels. Install approved thickness measuring gauges on 5 ft (1.5 m) centers in each direction to establish shotcrete thickness.

Do not apply shotcrete during heavy rains or runoff or high winds such that the nozzle stream separates during placement. Do not place shotcrete if surface to receive shotcrete is frozen or the air temperature measured at the location of the shotcreting operation in the shade away from artificial heat is below 40°F (4°C). Do not apply shotcrete if the shotcrete temperature is less than 50°F (10°C) or greater than 90°F (32°C). Protect shotcrete from freezing and rain until the shotcrete reaches initial set as determined by the Engineer.

Produce shotcrete of required strength, consistency, quality and uniformity with minimum rebound. Thoroughly mix materials in sufficient quantity to place continuously. Do not use rebound or previously expanded material in the mix. Apply shotcrete before the time between adding the mixing water and placement exceeds 60 minutes.

The Engineer will decide when and where to sample shotcrete and the number of samples to collect for field testing. One production test panel is required per 33 yd^3 (25 m^3) of shotcrete applied with a minimum of 1 test panel per day. Apply shotcrete to production test panels at the same time shotcrete is applied for the application during construction. Make, cure and core production test panels in the same way as required for preconstruction test panels in accordance with Section 4.0. The compressive strength of the shotcrete will be considered the average compressive strength test results of 3 cylinder specimens from the same production test panel at 28 days.

6.0 MISCELLANEOUS

Comply with Articles 1000-9 through 1000-12 of the *Standard Specifications* to the extent applicable for shotcrete in lieu of concrete.